Defense Threat Reduction Agency
8725 John J. Kingman Road, MS
6201 Fort Belvoir, VA 22060-6201

DTRA-IR-16-93

TECHNICAL REPORT

Nuclear Security Summit & Workshop 2015

"Preventing, Understanding and Recovering from Nuclear Accidents"--lessons learned from Chernobyl and Fukushima

September 2016

Tomoko Steen et al.

Prepared by:
Georgetown University
3700 O St NW
Washington, D.C. 20057

DESTRUCTION NOTICE:

Destroy this report when it is no longer needed.
Do not return to sender.

PLEASE NOTIFY THE DEFENSE THREAT REDUCTION AGENCY, ATTN: DTRIAC/ J9STT, 8725 JOHN J. KINGMAN ROAD, MS-6201, FT BELVOIR, VA 22060-6201, IF YOUR ADDRESS IS INCORRECT, IF YOU WISH IT DELETED FROM THE DISTRIBUTION LIST, OR IF THE ADDRESSEE IS NO LONGER EMPLOYED BY YOUR ORGANIZATION.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
00-09-2016	Conference Proceedings (Internal Report)	October 30 2015 - October 31 2016

4. TITLE AND SUBTITLE

Nuclear Security Summit & Workshop 2015
"Preventing, Understanding and Recovering from Nuclear Accidents"--lessons learned from Chernobyl and Fukushima

5a. CONTRACT NUMBER
N/A

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

6. AUTHOR(S)

Tomoko Steen
Samantha Das
Heather Meeks

5d. PROJECT NUMBER
N/A

5e. TASK NUMBER
N/A

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Georgetown University
3700 O St NW
Washington, D.C. 20057

8. PERFORMING ORGANIZATION REPORT NUMBER
N/A

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Library of Congress 101 Independence Ave SE, Washington, DC 20540
U.S. Department of State 2201 C St. NW Washington, DC 20520
Defense Threat Reduction Agency 8725 John J Kingman Rd, Ft Belvoir, VA 22060

10. SPONSOR/MONITOR'S ACRONYM(S)
LOC, DoS, DTRA

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
DTRA-IR-16-93

12. DISTRIBUTION / AVAILABILITY STATEMENT

Distribution Statement A. Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Nuclear Disaster Summit was a two-day international conference held at Georgetown University in Washington, D.C. Thought leaders with diverse expertise, including nuclear physics and engineering, biology, policy, security, and health issues participated in the event, designed to address: (1) prevention of nuclear accidents, (2) preparing and securing nuclear facilities in the event of catastrophic natural disasters, (3) assisting survivors in impacted areas in both the near- and long-term, (4) addressing near-term environmental consequences, (5) developing measures to facilitate environmental and economic recovery, and (6) implementing standardized policies for disaster preparedness and recovery.

15. SUBJECT TERMS

Fukushima, Chernobyl, nuclear disaster, environmental consequences

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	SAR	45	Heather Meeks
Unclassified	Unclassified	Unclassified			**19b. TELEPHONE NUMBER** *(include area code)* (703) 767-3059

UNIT CONVERSION TABLE

U.S. customary units to and from international units of measurement*

U.S. Customary Units	Multiply by → / ← Divide by†		International Units
Length/Area/Volume			
inch (in)	2.54	$\times 10^{-2}$	meter (m)
foot (ft)	3.048	$\times 10^{-1}$	meter (m)
yard (yd)	9.144	$\times 10^{-1}$	meter (m)
mile (mi, international)	1.609 344	$\times 10^{3}$	meter (m)
mile (nmi, nautical, U.S.)	1.852	$\times 10^{3}$	meter (m)
barn (b)	1	$\times 10^{-28}$	square meter (m^2)
gallon (gal, U.S. liquid)	3.785 412	$\times 10^{-3}$	cubic meter (m^3)
cubic foot (ft^3)	2.831 685	$\times 10^{-2}$	cubic meter (m^3)
Mass/Density			
pound (lb)	4.535 924	$\times 10^{-1}$	kilogram (kg)
unified atomic mass unit (amu)	1.660 539	$\times 10^{-27}$	kilogram (kg)
pound-mass per cubic foot (lb ft^{-3})	1.601 846	$\times 10^{1}$	kilogram per cubic meter (kg m^{-3})
pound-force (lbf avoirdupois)	4.448 222		newton (N)
Energy/Work/Power			
electron volt (eV)	1.602 177	$\times 10^{-19}$	joule (J)
erg	1	$\times 10^{-7}$	joule (J)
kiloton (kt) (TNT equivalent)	4.184	$\times 10^{12}$	joule (J)
British thermal unit (Btu) (thermochemical)	1.054 350	$\times 10^{3}$	joule (J)
foot-pound-force (ft lbf)	1.355 818		joule (J)
calorie (cal) (thermochemical)	4.184		joule (J)
Pressure			
atmosphere (atm)	1.013 250	$\times 10^{5}$	pascal (Pa)
pound force per square inch (psi)	6.984 757	$\times 10^{3}$	pascal (Pa)
Temperature			
degree Fahrenheit (^oF)	$[T(^oF) - 32]/1.8$		degree Celsius (^oC)
degree Fahrenheit (^oF)	$[T(^oF) + 459.67]/1.8$		kelvin (K)
Radiation			
curie (Ci) [activity of radionuclides]	3.7	$\times 10^{10}$	per second (s^{-1}) [becquerel (Bq)]
roentgen (R) [air exposure]	2.579 760	$\times 10^{-4}$	coulomb per kilogram (C kg^{-1})
rad [absorbed dose]	1	$\times 10^{-2}$	joule per kilogram (J kg^{-1}) [gray (Gy)]
rem [equivalent and effective dose]	1	$\times 10^{-2}$	joule per kilogram (J kg^{-1}) [sievert (Sv)]

*Specific details regarding the implementation of SI units may be viewed at http://www.bipm.org/en/si/.

†Multiply the U.S. customary unit by the factor to get the international unit. Divide the international unit by the factor to get the U.S. customary unit.

Background

The 1986 Chernobyl and the 2011 Fukushima accidents provoked world-wide concern about the ability of current incident response programs to adequately protect the public and the environment in the event of a nuclear disaster. Limited knowledge of nuclear physics and engineering within the general populace, as well as fears about possible health effects resulting from radiation exposure, spurred widespread panic among impacted and potentially impacted populations, whether proximal to or far-removed from reactor sites. Lack of centralized communication among experts was a probable driver of the rampant spread of misinformation that followed each accident.

The Chernobyl and Fukushima disasters measured Level 7 on the International Nuclear Event Scale (INES) according to the International Atomic Energy Agency (IAEA), but most members of public are unlikely to understand the meaning of such a measure or its implications. Moreover, nearly thirty years of collective evaluation of Chernobyl have provided only limited context. We still do not fully understand the nature and extent of the accidents or the probable long-term consequences, nor are we certain what actions we should take to prepare for future such disasters.

Statement of Purpose

The Nuclear Disaster Security Summit addressed the following:

- Preventing nuclear accidents
- Preparing for and securing nuclear facilities in the event of catastrophic natural disasters
- Assisting survivors in impacted areas for short and long-term periods
- Addressing near-term environmental consequences
- Developing measures to facilitate environmental and economic recovery
- Implementing standardized policies for disaster preparedness and recovery

The primary objective of the Nuclear Security Summit and Workshop was to bring policy leaders, emergency preparedness and response planners, economists, scientists, and engineers together to foster interdisciplinary and multi-national discussions on nuclear physics and engineering, biology, policy, security, and health care issues associated with nuclear disasters. The Summit instigated discussions among a diverse group of experts using the Chernobyl and Fukushima nuclear accidents as unique case studies, with the end goal of establishing a community of experts. Summit planners and sponsors sought concrete outcomes and engagements that may lead to pursuit of public-private partnerships, academic think-tank studies, scientist-scientist collaborations, and other activities necessary for sustaining dialogue within the nuclear disaster community.

Program Outline

The first day of the Summit consisted of presentations by thought leaders representing relevant disciplines, each followed by focused panel discussions. For the second day, Summit

attendees participated in workshops designed to promote more intimate discussion with next generation researchers (i.e., graduate students and post-doctoral fellows) and to provide information on training opportunities, and other topics of interest, as well as establishing long term collaborative projects.

OPENING SESSION

Time	Title	Speaker
8:00 – 8:05	Welcome to the Nuclear Security Summit & Workshop	**Dr. Tomoko Y. Steen**, Adjunct Professor, Biomedical Science Policy and Advocacy, Department of Microbiology and Immunology, Georgetown University Medical Center
8:05 – 8:10	Introducing Dr. Elliott Crooke, Senior Associate Dean, Faculty and Academic Affairs, Georgetown Medical School	**Dr. Evagelia Laiakis**, Assistant Professor; Biochemistry and Molecular & Cellular Biology, Georgetown University Medical Center
8:10 – 8:20	Welcome Remarks	**Dr. Elliott Crooke**, Professor and Chair, Biochemistry and Molecular & Cellular Biology, Senior Associate Dean, Faculty and Academic Affairs, Georgetown Medical School

Elliott Crooke, Ph.D. is Professor and Chair of Biochemistry and Molecular & Cellular Biology at Georgetown University Medical Center. He received his Ph.D. in Biological Chemistry from UCLA and carried out his postdoctoral research at Stanford University School of Medicine with Nobel Laureate Arthur Kornberg. Dr. Crooke's research focuses on two independent areas: cell-cycle control of chromosomal DNA replication and the role of polyphosphates in cellular responses to environmental stresses. Funding for his group has been provided by NIH, NSF, the Department of Defense, and the American Cancer Society. In 2013 he was appointed to the Editorial Board of The Journal of Biological Chemistry. Dr. Crooke has extensive experience in medical and graduate education and was the 2004 recipient of the Kaiser-Permanente Foundation Award for Excellence in Preclinical Teaching. In 2012, he assumed the role of Senior Associate Dean of Faculty and Academic Affairs for the School of Medicine and the School of Nursing and Health Studies at the Medical Center, a combined home for over 2250 faculty.

SESSION 1

Environmental, Psychological and Economic Effects of Radiation

Chair, Dr. Tomoko Steen, GUMC

Time	Title	Speaker
8:30 – 8:45	Bacterial Decay of Radioactive Waste	**Dr. Jonathan R Lloyd,** Professor, Williamson Research Centre for Molecular Environmental Science, School of Earth, Atmospheric and Environmental Sciences, University of Manchester
8:45 – 9:00	Remediation of Paddy Soil Contaminated by Radiocesium in Iitate Village of the Fukushima Prefecture	**Dr. Masaru Mizoguchi,** Professor, International Agro Informatics Laboratory, Department of Global Agricultural Sciences, the University of Tokyo
9:00 – 9:15	Issues of Trust in Nuclear Waste Management: the Swedish Experience	**Dr. Boel Berner**, Professor, Department of Thematic Studies – Technology and Social Change, Sweden
9:15 – 9:30	Overview of Radiation in Marine Environments from the Fukushima NPS Accident	**Dr. Tatsuo Aono**, Assistant Director, Project for Environmental Dynamics and Radiation Effects, Fukushima Project Headquarters, National Institute of Radiological Sciences, Japan
9:30 – 9:45	Psychological and Sociological Effects of Chernobyl Accident	**Dr. Robert Yaffee**, Research Professor, New York University, Silver School of Social Work
9:45 – 10:00	Recovery of Land and People in Fukushima	**Mr. Yooichi Tao**, Executive Director, NPO: Resurrection of Fukushima (*Fukushima saisei no kai*)

8:30 – 8:45

The microbiology of the nuclear fuel cycle; from the the bioremedation of contaminated land and water, to the safe disposal of radioactive waste

Dr. Jonathan R Lloyd

Professor, Williamson Research Centre for Molecular Environmental Science, School of Earth, Atmospheric and Environmental Sciences, University of Manchester

ABSTRACT

Microorganisms are able to colonise some of the most extreme environments on Earth, including highly radioactive environments associated with the nuclear fuel cycle. In nuclear facilities, microbial "blooms" can cause operational challenges and concerns regarding the long-term stability of stored nuclear waste. However, in contaminated land they can have a controlling influence on the solubility of actinides and fission products, and can be harnessed for non-invasive bioremediation. In the "far field" deep geosphere surrounding underground nuclear repositories, microorganisms can also immobilise redox-active radionuclides via respiratory processes that either directly change the oxidation state of the element, or produce new biogenic phases for enhanced sorption. In the "near field" of the repository, the direct and indirect impacts of microbial metabolism are less well characterised but have the potential to have a significant impact on wasteform evolution and radionuclide mobility. Recent work on the molecular ecology of a range of nuclear facilities will be presented, and the impact of microbial metabolism on various steps of the nuclear fuel cycle discussed.

BIOGRAPHY

Jon Lloyd is Professor of Geomicrobiology and Director of the Williamson Research Centre for Molecular Environmental Science, and is based in the School of Earth, Atmospheric and Environmental Sciences at the University of Manchester. He has published more than 200 papers in journals including Nature and Science, addressing the mechanism of microbial redox transformations of iron, and other metals, metalloids and radionuclides in a range of environmental and biotechnological contexts. He was awarded the 2006 Geological Society of London Bigsby Medal for his work on radionuclide biogeochemistry, and in 2014 was cited as one of the Top 100 Practicing UK Scientists by the UK Science Council. Between 2010-2014, he was a Royal Society Industrial Fellow working with the National Nuclear Laboratory, developing a wide-ranging nuclear microbiology programme with multiple academic and industrial partners, to help with nuclear plant operation, decommissioning, remediation and radwaste disposal in the UK and further afield.

8:45 – 9:00

Remediation of Agricultural land Contaminated by Radiocesium in Iitate Village, Fukushima Prefecture

Dr. Masaru Mizoguchi

International Agro Informatics Laboratory, Department of Global Agricultural Sciences, the University of Tokyo, Japan

ABSTRACT

Most of radiocesium released from Fukushima Daiichi nuclear power plant has been accumulated in the topsoil within 5 cm. For decontamination of the top soil, the Japanese government has authorized three methods: topsoil stripping method, puddling method, and plowing method to replace surface soil with subsoil. Among the three methods, the topsoil stripping method is being carried out and a lot of flexible container bags containing contaminated topsoil are piled up in the paddy field. However, we have not yet found the final disposal site of the contaminated soil. For agricultural regeneration and early return village, it is important to find a feasible decontamination method that farmers can conduct by themselves. Therefore, we are challenging some field tests that bury the contaminated soil under the ground or flushes out muddy water into a moat in the paddy. In this workshop, I will introduce our challenges collaborating with an NPO and farmers.

Keywords: radiocesium, decontamination, Fukushima, clay, monitoring

BIOGRAPHY

2010:	Professor, Graduate School of Agricultural and Life Science, the University of Tokyo
2008:	Professor, Interfaculty Initiative in Information Studies, the University of Tokyo
2005:	Associate Professor, Graduate School of Agricultural and Life Science, the University of Tokyo (International Agro Informatics Laboratory）
2003-2004:	Deputy Director of Council of Science and Technology Policy (Environment), Cabinet Office, Government of Japan
1999:	Associate Professor, Graduate School of Agricultural and Life Science, the University of Tokyo (Soil Physics and Soil Hydrology Laboratory）
1995:	Associate Professor, Department of Bioresources, Mie University (Agricultural Physics Laboratory)
1990:	Visiting Assistant Professor, Agronomy Department, Purdue University (U.S.A.)
1990:	Received Doctoral Degree of Agriculture, the University of Tokyo

1984: Assistant Professor, Agricultural Department, Mie University

1984: Ph.D. Course, Graduate School of Agriculture, the University of Tokyo

1982: M.S., Graduate School of Agriculture, the University of Tokyo

1982: B.S., Faculty of Agriculture, the University of Tokyo

9:00 – 9:15

Issues of trust in nuclear waste management: The Swedish experience

Dr. Boel Berner

Professor, Department of Thematic Studies – Technology and Social Change, Sweden

ABSTRACT

The presentation discusses the importance of public trust in the management of radioactive waste. After a referendum on nuclear power in 1980, the Swedish Nuclear Fuel and Waste Management Company (SKB) got the task to find a solution to the waste problem. Thirty years later, in 2011, it handed in an application to the State Nuclear Safety Authority and Environmental court to construct a final repository 500 metres down into crystalline rock. Sweden is thus one of the first countries to present a technical solution to the problem of what to do with spent nuclear fuel. The presentation discusses how local acceptance for a repository was achieved, despite initial mistakes which resulted in resistance and conflicts and despite considerable distrust of nuclear power in society. It is argued that trust in the technology and in the nuclear industry cannot be assumed but must be earned through political processes based on transparency, involvement and a multiplicity of voices.

BIOGRAPHY

Boel Berner is a sociologist and historian, and professor emerita at the Department of Thematic Studies – Technology and Social Change, Linköping university, Sweden. Her research has focused on the role of technical knowledge in society, on medical technologies, and on risk and safety in technical change. She was scientific expert for the social science research programme on nuclear waste issues, funded by the Swedish Nuclear Fuel and Waste Management Company (SKB) between 2004 and 2010.

Relevant publications in English are: *Social Science Research 2004–2010. Themes, results and reflections (on nuclear waste issues)* (with Britt-Marie Drottz Sjöberg and Einar Holm), Stockholm, 2011; *Knowledge and evidence: Investigating technologies in practice* (ed. with Corinna Kruse), Linköping 2014; *Constructing risk and safety in technological practice* (ed. with Jane Summerton), London, 2003.

9:15 – 9:30

Overview of Radiation in Marine Environments from the Fukushima NPS Accident

Dr. Tatsuo Aono

Assistant Director, Project for Environmental Dynamics and Radiation Effects, Fukushima Project Headquarters, National Institute of Radiological Sciences, Japan

ABSTRACT

An accident of the TEPCO's Fukushima Daiichi Nuclear Power Station (FDNPS) has been passed about over four and half years since March 2011. The high levels of radiocaesium and 131I in seawater, sediments and biota in the coastal area of Fukushima had been caused by deposition in the ocean and direct release of the highly contaminated water to the ocean during the end of March to the early April in 2011. The radiocaesium and 131I activities in seawater had exponentially decreased to the activities before the accident over time. However, these in sediment and marine biota have decreased more slowly than in seawater and have had large fluctuations. It is necessary to clarify the effects of the Fukushima-derived radionuclides in marine biota off Fukushima. The aim of the study is to examine the temporal and spatial variation of radioactivity in marine biota after this accident. Studies on the effects of radiation on marine biota off Fukushima will be presented with some assessment models.

BIOGRAPHY

Dr. Tatsuo Aono is an assistant director of Project for Environmental Dynamics and Radiation Effects, Fukushima Project Headquarters, National Institute of Radiological Sciences, Japan. His research extends to various processes of material cycling in the ocean using radionuclide as a tool, and transfer processes of radionuclides in marine environment. His current research focuses on the effect of radiation for non-human biota in marine environment, and also food safety since the Fukushima NPS accident.

9:30 – 9:45

Psychological and Sociological Effects of Chernobyl Accident

Dr. Robert Yaffee

Research Professor, New York University, Silver School of Social Work

ABSTRACT

Our objectives were to examine predictive parameters of psychological impacts, resulting from the Chornobyl accident, on residents living in the oblasts of Kiev and Zhitomyr. We tested drivers for psycho-social depression based on estimates radiological dose received from radioactivity release during the accident and the perception of increased health effects associated with this radiation. To obtain a representative sample of individuals, we attached computer generated random numbers to area codes provided by the telephone company. In January 2009, Russia created an intervening crisis by interrupting supplies of natural gas to the Ukraine. We employed scenario forecasting to circumvent crisis effects that could otherwise undermine the internal validity of our study. State space methods were used to model trajectories of psycho-social anxiety reported by respondents. Results of the dose reconstruction process revealed that the dose received by this population was too low to identify pathological disease or injury. From empirical analysis, we found that the psychological impacts of the nuclear incident stemmed from perceived Chornobyl-related health risk rather than external dose.

BIOGRAPHY

Robert Alan Yaffee, Ph.D. served as a research professor at the Silver School of Social Work, New York University, a Senior Research Scientist on a National Science Foundation HSD grant 0826983 to study psychosocial effects of the Chornobyl nuclear accident from 2008 through 2012, and as a research scientist on an NIMH grant from 1995 to 2000 with the Department of Geriatric Psychiatry at SUNY Downstate Medical Center. While a statistical consultant at N.Y.U.'s Academic Computing Facility and as a senior research and statistical consultant at the Information Technology Services, he was a volunteer forecasting consultant to the Special Pathogens Branch of the U.S. Centers for Disease Control from 2001 to 2008. He has taught time series analysis and forecasting since 2006 for Timberlake Consultants, Ltd, both in the U.S. and in Europe. In 1988-1989, he was also as an Associate Research Scientist in Columbia University's School of Public Health.

9:45 – 10:00
Recovery of Land and People in Fukushima

Mr. Yooichi Tao

Executive Director, NPO: Resurrection of Fukushima (Fukushima saisei no kai), Visiting Researcher, Kogakuin University

ABSTRACT

The attribution of cause and result of the Fukushima nuclear accident to Tsunami is wrong. People in the areas contaminated with fallout have been devastated by confusion of policy makers and TEPCO since 2011. At least 120 thousand people have been forced to live as refugees for this 4 and half years, and have had distrusts of policy makers and authorities. Activities in the contaminated area have to be collaborative with victims as well as various organizations. In order to decide whether to return their homeland or to migrate to elsewhere, they need support and trustworthy information about radioactive substances. Cooperating and collaborating with universities and research institutes, we developed a monitoring system, trained victims as monitoring car operators, experimenting various decontamination methods, and demonstrating the drip fertigation system. Activities in the area have to be holistic as the contamination affects every aspect of life.

BIOGRAPHY

Yooichi Tao was born in 1941 in Yokohama City. He earned a master's degree in physics (high energy accelerator physics) from the University of Tokyo's Graduate School of Science in 1967. In 1979, he established private-sector think tank Laboratory for Innovators of Quality of Life and became its president and CEO. He is also the exhibit/interior systems producer of the Yokohama Children Science Musium and the RAM editor-in-chief for a computer magazine. In 1985, he established Video Techs Center, a joint venture with SECOM, and became its representative director. Since April 1991, he was also the Information Strategy Department director of SECOM. From 1995 to 2005, he served on the board of directors for the same company, and in the meantime, he was also the president of Tokyo Internet KK, the president and CEO of SECOM Information Systems Co., Ltd., Entrust Japan Co., Ltd., SECOM Trust Net Co., Ltd., and the managing CIO/CISO of SECOM Co., Ltd.

He is also the director of Japan PKI Forum, the deputy secretary-general of the Millennium Project/GPKL Systems Exploratory and Management Committee, a member of the Commission on Critical Infrastructure Protection, the chairman of the Partnership/Adjustment Department of JESAP (Japan Electronic Signature and Authentication Partnership), a member of the Office of IT Security Policy, a member of the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society, and he is on the Information Security Policy Council, the Expert Panel on Technological Strategy, and the Electronic Government Evaluation Committee. The Social System Design Project, Executive Manager.

Publications/Translations:

- "Sekai no Kagakukan wa Ima (update on the world's science museums)" (Shinkigensha)
- "Video Techs e no Shotai (invitation to Video Techs)" (Shinkigensha)
- "Suchi Keisanho Giron (discussion on numeric calculation method)" (Saiensu-sha)
- "π no Rekishi (history of the π)" (Chikuma Bungei Bunko)

SESSION 2

Biological Effects of Radiation

Chair, Dr. Heather Meeks, DTRA

Time	Title	Speaker
10:30 – 10:45	Health Effects of Prenatal or Childhood Radiation Exposure	**Dr. Roy Shore**, Chief of Research, Radiation Effects Research Foundation *retired
10:45 – 11:00	Gut Microbiome and Radiation	**Dr. Soumen Roy**, Staff Scientist, Cancer and Inflammation Program, National Cancer Institute, NIH
11:00 – 11:15	Biological Impacts of Radiation on Small Animals in Chernobyl and Fukushima	**Dr. Timothy Mousseau**, Professor of Biological Sciences, Department of Biology, University of South Carolina
11:15 – 11:30	Combined Injury: Radiation and Wounds	**Dr. Juliann G. Kiang**, Professor & Program Advisor, Radiation Combined Injury; Armed Forces Radiobiology Research Institute (AFRRI); Professor, Department of Radiation Biology; Research Professor, Department of Medicine; Uniformed Services University (USU)

10:30 – 10:45
Health Effects of Prenatal or Childhood Radiation Exposure

Dr. Roy Shore

Chief of Research, Radiation Effects Research Foundation *retired

ABSTRACT

Various health effects of prenatal radiation exposure have been documented. At doses over 100 mGy there is evidence of embryonic loss after exposure at 0-7 weeks post-conception and neurocognitive deficits after exposure at 8-25 weeks post-conception. There is also evidence of excess risk of solid cancer and probably cardiovascular disease. However, the risk of adult diseases is not greater after prenatal exposure than after childhood exposure. Childhood exposure confers about 2-5 times as much lifetime risk of cancer as does exposure in adulthood, in part because there is a longer length of time for cancer to be expressed. The ratio of lifetime cancer risks by childhood:adult exposure varies by cancer site with the ratios for thyroid cancer and breast cancer being notably high. However, no evidence has been found to date that the offspring of those exposed to radiation as children have excess risk of genetic defects or cancer.

BIOGRAPHY

Roy Shore, PhD, DrPH served as a Professor and director of the Epidemiology Division at New York University School of Medicine, Department of Environmental Medicine before serving as the Vice Chairman and Chief of Research to direct studies of atomic bomb survivors' health at the Radiation Effects Research Foundation (RERF) in Hiroshima-Nagasaki. He has published widely on epidemiologic radiation research, with interests in cancer and various non-cancer conditions such as cardiovascular disease and cataract. He has served on numerous scholarly committees on radiation risk, including as a long-time member of the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP), and various committees or task groups for UNSCEAR, WHO, the U.S. National Academy of Sciences, the U.S. National Cancer Institute and the U.S. Environmental Protection Agency.

Sample papers:

Shore RE. Radiation impacts on human health: certain, fuzzy and unknown. Health Phys, 106(2):196-205, 2014.

UNSCEAR (Mettler F, Constine L, Nosske D, Shore R). Sources, Effects and Risks of Ionizing Radiation, Vol. II, Scientific Annex B: Effects of radiation exposure of children. United Nations Scientific Committee on the Effects of Atomic Radiation, 2013, 269 pp.

10:45 – 11:00
Gut Microbiome and Radiation

Dr. Soumen Roy

Staff Scientist, Cancer and Inflammation Program, National Cancer Institute, NIH

ABSTRACT

Radiation therapy has been used in the clinic since 1896; immediately after its discovery by William Roentgen in 1895. Besides having tremendous anti-cancerous potential, radiation therapy also caused toxicity in adjacent tissues. Of the most prevalent types of cancer, 30% are pelvic cancer which might require radiation therapy; that ultimately leads to severe toxicity in the gut. It has been recently shown that depletion of gut microbiota with antibiotics reduced the therapeutic efficacy of chemotherapeutics; therefore, we speculate that gut microbiota might play a role in radiation-mediated cancer therapy. Although the mechanism of radiation-mediated toxicity has been elucidated, a dearth of information remains regarding the role of gut microbiota in tumor clearance by radiation therapy and the resolution of radiation-induced toxicity. Profiling of gut microbiota and identifying the mechanisms induced by microbial signaling in this context might help to prevent radiation-induced toxicity and also to develop microbiota based therapeutic strategy.

Soumen Roy, Dr. rer. nat and Giorgio Trinchieri, MD

BIOGRAPHY

Dr. Roy is currently working in the field of cancer and gut microbiota at the National Cancer Institute (NCI), NIH in the laboratory of Dr. Giorgio Trinchieri. His main focus is to investigate the role of gut microbiota in radiation therapy as well as in chemotherapeutic drug induced local and systemic toxicity.

Prior joining the National Cancer Institute, Dr. Roy worked at the National Institutes on Deafness and other Communication Disorders (NIDCD) in the Laboratory of Dr. Lisa Cunningham, where he contributed to the development of a sound conditioning based co-therapy, which inhibits cisplatin and aminoglycoside mediated hearing loss in mice.

Dr. Roy received his doctorate degree in the field of targeted nanomedicine from the University of Innsbruck, Austria in 2011.

11:00 – 11:15

Biological Impacts of Radiation on Small Animals in Chernobyl and Fukushima

Dr. Timothy Mousseau

Professor of Biological Sciences, Department of Biology, University of South Carolina

ABSTRACT

Recent scientific studies of the plants and animals living in Chernobyl, Fukushima and other naturally radioactive regions around the world provide strong evidence that exposure to low dose radiation stemming from radionuclides in the environment can lead to elevated mutation rates, reduced fertility and longevity, increased rates of developmental abnormalities and tumors, reduced biodiversity and population abundances, and broader ecosystem effects. Analysis of these findings indicate that there is no threshold radiation level below which biological consequences are not observed and that even very low levels of exposure can measurably impact natural populations, particularly following multiple generations of chronic exposure. Dr. Mousseau will summarize and discuss studies on plants and animals in Fukushima and how these compare to previous findings from studies in Chernobyl.

BIOGRAPHY

Timothy Mousseau is a Professor of Biological Sciences at the University of South Carolina (USC). Former positions include Associate Vice President for Research and Dean of the Graduate School at USC, and Program Officer for Population Biology at the U.S. National Science Foundation. He has served on U.S. National Academy of Science committees to examine health hazards related to living near nuclear power plants. His research is concerned with the ecology and evolution of animals and plants with a special interest in how adaptations to changing environments evolve in natural populations, and the evolution of adaptive maternal effects. Since 2000, he and his colleagues have studied the impacts of radioactive fallout from the Chernobyl disaster on natural populations of birds, insects, plants and microbes, with more than 80 scientific publications on this topic. More recently, he has travelled to Fukushima, Japan, to study the impacts to biota of the high radiation levels found in this region.

11:15 – 11:30
Combined Injury: Radiation and Wounds

Dr. Juliann G. Kiang

Professor & Program Advisor, Radiation Combined Injury; Armed Forces Radiobiology Research Institute (AFRRI); Professor, Department of Radiation Biology; Research Professor, Department of Medicine; Uniformed Services University (USU)

ABSTRACT

Kiang et al. (2014) Ghrelin therapy improves survival after whole-body ionizing irradiation combined with wound or burn: Amelioration of leukocytopenia, thrombopenia, splenomegaly, and bone marrow injury. Oxid Med Cell Longev 2014: 215858, PMID: 25374650

Exposure to ionizing radiation alone (radiation injury, RI) or radiation combined with traumatic tissue injury (radiation combined injury, CI) is a crucial life-threatening factor in nuclear and radiological accidents. Radiation injuries occur at the molecular, cellular, tissue, and system levels. In our laboratory, we found that B6D2F1/J female mice exposed to ^{60}Co-γ-photon radiation (9.5 Gy, 0.4 Gy/min, bilateral) followed by 15% total-body-surface-area skin wounds (R-W CI) or burns R-B CI) experienced an increment of ≥18% higher mortality over a 30-day observation period compared to irradiation alone. CI was accompanied by severe leukocytopenia, thrombopenia, erythropenia, and anemia. At the 30th day post-injury, numbers of neutrophils, lymphocytes, and platelets remained very low in surviving RI and CI mice. In contrast, their RBC, hemoglobin, and hematocrit readings were similar to pre-irradiation levels. Only RI induced splenomegaly. Both RI and CI resulted in bone-marrow cell depletion. Hunger simulates release of the 28-amino-acid-peptide ghrelin from the stomach. In R-W CI mice, ghrelin treatment (113 μg/kg, i.v., +1d, +2d, +3d once daily) significantly increased 30-day survival and mitigated CI-induced body-weight loss, accelerated wound healing, and increased hematocrit readings. In R-B CI mice, ghrelin treatment significantly increased 30-day survival and numbers of neutrophils, lymphocytes, monocytes, basophils, and platelets, and ameliorated bone-marrow cell depletion. In a time-course study, ghrelin significantly reduced IL-6 concentrations and sustained increases in G-CSF concentration in R-W CI mice. The results suggest that ghrelin effectively sustained animal survival by mitigating radiation-induced leukocytopenia, thrombopenia and IL-6 as well as alleviating bone-marrow injury, but sustained increases in G-CSF. (The work was supported by NIH/NIAID YI-AI-5045-04 and AFRRI RAB32164 & 33529. The views, opinions, and findings contained in this presentation do not reflect official policy or positions of the U.S. Department of Defense or the U.S. Government.)

BIOGRAPHY

Juliann G. Kiang completed her Ph.D. and postdoctoral studies at the University of California at Berkeley. She is a professor of Radiation Biology at the Uniformed Services University of the Health Sciences, Bethesda, MD and Principal Investigator at Armed Forces Radiobiology Research Institute. She is an inventor and editorial member of journals. She has 3 patents and over 140 publications. Among all awards, she received the Research and Development

Achievement Award from the U.S. Department of Army. She is a U.S. DoD STEM model. She was the first to describe the skin-wound amplifies iNOS activation, cytokine concentrations, and sepsis after ionizing irradiation, which explains why the skin-wound elevates the radiation-induced lethality. She identifies that ciprofloxacin and ghrelin that can impede iNOS activation, proinflammatory cytokines, and/or sepsis are in success to improve survival after irradiation combined with wound trauma. Currently, she is investigating the correlation between miRNA and combined injury-induced signal enhancement.

Keywords – Signal transduction pathways, Radio-protectants, Radio-mitigators, Radiotherapy

My current research is focused on radiation combined with tissue trauma caused by wound, burn, or hemorrhage. This radiation combined injury results in mortality greater than radiation alone. We desire to (1) elucidate the underlying mechanisms and (2) identify countermeasures to prevent, mitigate, or treat radiation combined injury.

SESSION 3

Nuclear Policy and Diplomacy

Chair, Professor Richard Love, NDU/DoD

Time	Title	Speaker
1:20 – 1:35	Nuclear Accidents and Diplomacy	**Dr. Andrew W. Reynolds**, UN Commissionor on Science and Technology for Development, Senior Advisor for Space and Advanced Technologies, Office of International Communications and Information Policy. U.S. Department of State
1:35 – 1:50	The National Academy's Committee on Fukushima	**Dr. Norman Neureiter**, Chairman of the NAS Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of U.S. Nuclear Plants; Director Emeritus, Science, Technology and Security Policy, AAAS
1:50 – 2:05	Origin of Environmental Protection Agency and Nuclear Regulation.	**Dr. Alan Moghissi,** President of the Institute for Regulatory Science, Geoerge Mason University; Adjunct Professor at Georgetown Medical School; Founding Member of the EPA

1:20 – 1:35
Nuclear Accidents and Diplomacy

Dr. Andrew W. Reynolds

UN Commissionor on Science and Technology for Development, Senior Advisor for Space and Advanced Technologies, Office of International Communications and Information Policy. U.S. Department of State

ABSTRACT

A checkered history underlies civilian nuclear power and the international relations that ushered in the technology under the Atoms for Peace program in 1954. The accidents at Three Mile Island, Chernobyl and Fukushima effected changes in regulation, construction schedules, associated capital costs, and public acceptance. While all three accidents had deleterious localized and regional radiological and safety consequences, Fukushima created geopolitical, economic and environmental impacts with additional global implications. After the accident many reactors around the world were taken offline temporarily for inspections. However, all nuclear plants in Japan and many in Germany were removed from active service for an indefinite period that continues today and the latter declared its intention to permanently retire all nuclear plants by 2022. Replacement power for these outages has cost hundreds of billions of dollars, increased reliance on fossil fuels and affected emission profiles and targets with concomitant implications for diplomacy and international relations.

BIOGRAPHY

Since August 2000, Dr. Reynolds, a career civil servant, has served as Deputy and chief of staff for the Office of the Science and Technology Adviser to the Secretary of State (STAS), U.S. Department of State. The STAS leads efforts to augment S&T personnel and literacy at the Department, to strengthen outreach to the domestic and international S&T community, and to foster mid- to long-term strategic planning to address science, engineering and technology issues in foreign policy at State Department and within the U.S. government, including the defense and intelligence communities.

Dr. Reynolds began his career in 1974 with Systems Sciences Incorporated, Washington, D.C., as a researcher for energy and public health issues. He joined the Federal Energy Agency in 1975 and, subsequently, the Energy Information Administration of the Department of Energy (DOE), where he specialized in electricity, nuclear power and energy supply and demand forecasting and analysis. From 1983-1986, Reynolds was posted in Paris as DOE Representative for Europe in the U.S. Mission to the Organization for Economic Cooperation and Development. He returned to Washington as Deputy Director for the DOE Office of International R&D Cooperation where he managed the U.S./U.S.S.R. Peaceful Uses of Atomic Energy agreement. He is an expert on the Three Mile Island and Chernobyl accidents.

Dr. Reynolds joined the State Department in 1990 as Deputy Director of the Office of Science and Technology Cooperation and, in 1994-96, served as S&T advisor to the U.S./Russia Cooperative Commission co-chaired by Vice President Al Gore and Russian Prime Minister Viktor Chernomyrdin. From October 1996 to August 2000, Reynolds was

posted as Counselor for Environment, Science and Technology at the U.S. Embassy in Rome under a Limited Foreign Service appointment. During his career he has been regularly recognized for his performance and service, including with Meritorious and Superior Honor Awards from the Department of State.

Dr. Reynolds capably speaks and reads Spanish, Italian, French, and some German.

1:35 – 1:50
The National Academy's Committee on Fukushima

Dr. Norman Neureiter

Chairman of the NAS Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of U.S. Nuclear Plants; Director Emeritus, Science, Technology and Security Policy, AAAS

ABSTRACT

The U.S. Congress asked the National Academy of Sciences to examine the causes of the accident at the Fukushima nuclear plant and identify lessons learned for the U.S. Daiichi personnel at the plant responded to the Great East Japan Earthquake and tsunami with courage and resilience, and their actions likely reduced its severity and the magnitude of offsite radioactive material releases. However, several factors relating to the management, design, and operation of the plant prevented them from achieving greater success and contributed to the overall severity of the accident. The Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants made several recommendations to increase and improve information transmission, plant systems, risk assessment, regulations, emergency mitigation and response, and safety culture within the industry.

BIOGRAPHY

Norman P. Neureiter, Ph.D., is a senior advisor American Association for the Advancement of Science. Dr. Neureiter received his Ph.D. in organic chemistry from Northwestern University in 1957. By 1963, he had begun his long career in science diplomacy; beginning with the newly established U.S.-Japan Cooperative Science Program (NSF), then the U.S. Foreign Service as Deputy Scientific Attaché (Bonn, 1965), and finally onto Warsaw as the first U.S. Scientific Attaché in Eastern Europe (1967). Dr. Neureiter returned to Washington in 1969 to work in the White House Office of Science and Technology and joined Texas Instruments (TI) in 1973, eventually becoming vice president of TI Asia (Tokyo) in 1989. He returned to government upon his appointment as the first science and technology adviser to the U.S. Secretary of State (2000-2003). The National Academy of Sciences has named him a Distinguished Presidential Fellow for International Affairs (2003) and awarded him the Public Welfare Medal (2008). In 2010, the Emperor of Japan awarded him the Order of the Rising Sun.

1:50 – 2:05

REGULATING EXPOSURE TO IONIZING RADIATION: CONSEQUENCES OF POLICY-BASED SCIENCE

Dr. Alan Moghissi

President of the Institute for Regulatory Science, Geoerge Mason University; Adjunct Professor at Georgetown Medical School; Founding Member of the EPA

ABSTRACT

This paper attempts to summarize the evolution of the regulations dealing with the exposure to ionizing radiation at the Environmental Protection Agency (EPA). Subsequent to a brief introduction, the paper describes the e experience of the author as a senior staff member of the EPA. The next part describes the evolution of regulatory science as applied to the development of relevant regulations. The example of disposal of high-level radioactive waste is used to demonstrate how the inclusion of ideology impacted the evolution of the EPA regulation. The paper uses the concept of Best Available Science (BAS) concept and Metrics for Evaluation of Scientific Claims (MESC) derived from BAS and uses the BAS/MESC system to assess claims on effects of ionizing radiation at various exposure levels. In the next part the BAS/MESC system is used to describe the level of maturity of science used in the regulatory process. In particular, the paper demonstrates that the scientific foundation of the current radiation regulations is at best judgment and more likely speculation or even fallacious Science. Finally, the paper attempts to compare the level of maturity of science to the costs of implementing regulations on ionizing radiation. In effect, whereas the science is most likely speculation, the costs of complying with the regulations are real.

BIOGRAPHY

A. Alan Moghissi is President of the Institute for Regulatory Science, a non-profit organization dedicated to the principle that societal decisions must be based on best available scientific information. He is also an adjunct professor at Georgetown University School of medicine and a Senior Fellow and Member of the Board of Regents at the Potomac Institute for Policy Studies in Arlington, Virginia, and is associated with several universities.

Dr Moghissi has served as senior manager at Environmental Protection Agency, University of Maryland, Baltimore and Temple University. He has published over 400 papers and 25 books. He also managed over 300 independent peer reviews and scientific assessments for the U.S. Congress and government agencies at federal, state, and local levels.

Alan Moghissi received his education in Zurich, Switzerland at the University of Zurich and Federal Institute of Technology (ETH) and the Technical University of Karlsruhe (now Karlsruhe Institute of Technology) in Germany, where he received a doctorate degree in physical chemistry.

SESSION 4

Management of Nuclear Power Accidents

Chair, Dr. Elizabeth Prescott, Professor, National Defense University

Time	Title	Speaker
2:30 – 2:45	Fukushima: Lessons Learned (and Not Learned) for Nuclear Safety	**Dr. Edwin Lyman**, Senior Global Security Scientist, Union of Concerned Scientists
2:45 – 3:00	Imaging nuclear reactors with cosmic ray muons	**Dr. J. Matthew Durham**, Los Alamos National Laboratory
3:00 – 3:15	Alternatives to Nuclear Reactors for Energy and Medical Isotopes	**Dr. Seth Hoedl**, Fellow at the Emmett Environmental Law & Policy Clinic, Harvard Law School
3:15 – 3:30	A Future of Nuclear Power	**Dr. Gong Ping Yeh**, Senior Physicist at Fermi National Laboratory; Fellow at American Physical Society

2:30 – 2:45

Fukushima: Lessons Learned (and Not Learned) for Nuclear Safety

Dr. Edwin Lyman

Senior Global Security Scientist, Union of Concerned Scientists

ABSTRACT

In the aftermath of the Fukushima Daiichi disaster, regulators around the world quickly identified the primary deficiencies in nuclear power operation and government oversight that contributed to the accident. A common thread was complacency: overconfidence in the robustness of nuclear plant systems to withstand severe accidents and the abilities of plant workers and emergency management personnel to cope with them. However, nearly five years later, efforts to address these deficiencies have faltered. In the United States, a task force appointed by the Nuclear Regulatory Commission (NRC) proposed a comprehensive plan to fix long-standing gaps in nuclear safety regulation, but ultimately the NRC rejected most of its recommendations and watered down or chopped up the others. The outcome of this process is a largely industry-driven program that makes some ad-hoc safety improvements but does not go far enough to ensure adequate protection of public health and the environment.

BIOGRAPHY

Edwin Lyman is a senior scientist at the Union of Concerned Scientists in Washington, DC. He earned a doctorate in physics from Cornell University in 1992. From 1992 to 1995, he was a postdoctoral research associate at Princeton University's Center for Energy and Environmental Studies (now the Science and Global Security Program). His research focuses on the prevention of nuclear proliferation, nuclear and radiological terrorism, and nuclear accidents. He has published articles and letters in journals and magazines including Science, The Bulletin of the Atomic Scientists, Science and Global Security, Arms Control Today, Nuclear Engineering International and Energy and Environmental Science. He is a co-author (with David Lochbaum and Susan Q. Stranahan) of the book Fukushima: The Story of a Nuclear Disaster (The New Press, 2014).

2:45 – 3:00
Imaging nuclear reactors with cosmic ray muons

Dr. J. Matthew Durham

Los Alamos National Laboratory

ABSTRACT

The Earth is constantly being bombarded by highly energetic particles from space that interact in the upper atmosphere to create natural showers of harmless ionizing radiation. Most of the particles that reach the Earth's surface are muons; these ubiquitous charged particles can be used to construct images of the interior of dense objects. Unlike more typical radiographic probes (such as x-rays), muons can penetrate large amounts of material and provide tomographic information on the interior of large objects, containers, and structures. This talk will discuss applications of muon radiography to imaging nuclear reactors, show some proof-of-principle measurements, and, in particular, discuss how the technique can aid cleanup efforts at the damaged Fukushima Daiichi nuclear reactors in Japan.

BIOGRAPHY

J. Matthew Durham is a nuclear physicist at Los Alamos National Laboratory. He studied at the University of Texas and Stony Brook University, receiving his PhD in experimental physics for work on heavy quark production in ultra-relativistic nuclear collisions. His research interests include technology for national security applications, phases of quantum chromodynamics, and development of advanced particle detectors.

3:00 – 3:15
Alternatives to Nuclear Reactors for Energy and Medical Isotopes

Dr. Seth Hoedl

Fellow at the Emmett Environmental Law & Policy Clinic, Harvard Law School

ABSTRACT

Alternatives to nuclear reactors for the production of energy and medical isotopes are becoming more technically and financially viable. This talk will briefly discuss how the price of solar power is approaching the price of nuclear power, at least in the U.S., and will provide an overview of how current accelerator technology, including commercially available cyclotrons, electron linear accelerators, and spallation neutron sources, can produce twelve commonly used medical radio-isotopes without the use of reactors or enriched uranium.

BIOGRAPHY

Dr. Seth Hoedl is presently a Fellow at the Emmett Environmental Law & Policy Clinic at Harvard Law School where he focuses on legal and regulatory issues associated with distributed energy resources, such as solar power and novel forms of energy delivery called "microgrids." Dr. Hoedl also writes about legal and technical issues associated with the peaceful use of nuclear technologies. Prior to his legal career, Dr. Hoedl was an academic nuclear physicist and helped run a biotech startup company that fabricates radioactive devices for cancer therapy. Dr. Hoedl holds a B.S. in Physics from Stanford, a Ph.D. in Physics from Princeton, and a J.D. from Harvard Law.

3:15 – 3:30
Nuclear Energy Prospects

Dr. Gong Ping Yeh

Senior Physicist at Fermi National Laboratory; Fellow at American Physical Society

ABSTRACT

Sustainable energy is the greatest human responsibility, challenge, opportunity, and endeavor. Energy is an important key to national and world security, economy, environment, prosperity. Fossil fuel carbon emissions are the world's biggest problem. Renewable energies can already annually add electricity equivalent to 50 new nuclear reactors. The world should use renewable energies as much as possible. Investment in nuclear power in the past few years was only about 10% of the investment for renewable energies during the same period. The 400 reactors in the world provide 2.6% of the world's energy, reducing carbon emissions by only 2.6%. More than 200 nuclear reactors will be decommissioned in the next 20 years. Nuclear power has 5 fundamental challenges: safety, waste, proliferation, cost, sustainability. Molten salt reactor, Thorium Energy, and Accelerator Driven System are promising solutions for nuclear power. China and India are racing for thorium energy, both looking to lead the world in this new source of energy. International Thorium Energy Conference in Mumbai and a 50 year anniversary celebration of the 1965-1969 successful operation of the Molten Salt Reactor Experiment at Oak Ridge National Laboratory, were held in October 2015.

Keywords: sustainable energy, thorium, nuclear

BIOGRAPHY

Dr. Gong Ping (G.P.) Yeh has been a high energy physicist since 1985 at Fermi National Accelerator Laboratory of the U.S. Department of Energy. Born in Taiwan, he received education from an international high school in Okinawa, his B.S. from MIT, M.S. from Caltech, and Ph.D. from MIT. He is an American Physical Society Fellow and Okinawa Goodwill Ambassador. Dr. Yeh's work and contributions include the discovery of the Top Quark, pioneering large scale supercomputing using Linux, and creating new Particle Therapy centers for treating tumor patients in Illinois, Taiwan, and other countries. He served as a member of the Republic of China Taiwan's Presidential Science and Technology Advisory Committee and as Special Advisor to Japan's Minister of Science and Technology Policy to create Okinawa Institute of Science and Technology. He is invited to the Science and Technology in Society Forum, the World Science Forum, and other gatherings of leaders worldwide for solving the world's biggest challenges including energy, water, food, health, environment, and education. His research and interests in sustainable energy include wind, solar, biofuels, electric vehicles, and improving energy efficiencies. In recent years, he has also focused on Accelerator Driven System and Thorium energy as a new source of energy.

Dr. Yeh has been serving internationally as an advisor for sustainable energy in many countries.

http://www-cdf.fnal.gov/cd/gp.html

SESSION 5

Keynote Address

Time	Title	Speaker
4:00 – 4:05	Introduction of the keynote speaker	**Dr. Tomoko Y. Steen**, Georgetown Medical School
4:05 – 4:35	Keynote Address	**Dr. William J. Schull**, Professor Emeritus at The University of Texas, School of Public Health; President, Schull Institute; and a Former Director of the Radiation Effects Research Foundation

Dr. William J. Schull has contributed extensively to human genetics and public health for over five decades, the last three in Houston. Prior to his retirement, he was Ashbel Smith Professor of Academic Medicine at The University of Texas Health Science Center at Houston. He was the Health Science Center's Inaugural President's Scholar. He is also the recipient of the Silvio O. Conte Environmental Health Award, and in 1992, he was awarded the Order of the Sacred Treasure Third Class by the Emperor of Japan, the highest honor bestowed on foreign, non-diplomatic individuals. In addition to being an author of over 400 publications, including 14 books, he has served on numerous editorial boards, as a visiting professor in several universities, and on more than 40 national and international panels. He has worked tirelessly on reports that summarize knowledge on the effect of exposure to ionizing radiation; these reports have guided the United States, the United Nations and the World Health Organization in formulating policies that affect us all. While these accomplishments speak to a lifetime of sustained scientific productivity, it is only when his research themes are fully examined; that one begins to sense the true depth and breadth of Dr. Schull's contributions to the world community. His research career reveals three recurring themes. First, a career-long interest in the effects of radiation exposure on the survivors of the atomic bombing of Hiroshima and Nagasaki. Second, his focus on the genetics of populations and the epidemiology of chronic disease conditions. Third, his continuous interest in the creation and maintenance of research environments in which early career scientists and clinicians are free to flourish.

SESSION 6

Overall discussion and Recovery Efforts

Time	Title	Speaker
4:40 – 4:55	"What can we do for the recovery of Chernobyl and Fukushima and prevention of future nuclear disasters?"	**Professor Richard Love**, Professor, NDU/DoD; Dr. Tomoko Steen,GUMC; Dr. Elizabeth Prescott, NDU; Dr. Heather Meeks, DTRA; Dr. Evagelia Laiakis, GUMC; Ms. Astrid Lewis, U.S. Dept. Of State
4:55 – 5:00	Closing Remarks	**Dr. Richard Calderone**, Chair & Professor, Department of Microbiology and Immunology, Director, Biomedical Science Policy and Advocacy Program, Georgetown Medical School

4:40 – 4:55
"What can we do for the recovery of Chernobyl and Fukushima and prevention of future nuclear disasters?"

Richard A. Love is a professor and senior research fellow at National Defense University (NDU) where he focuses on national and international security issues including weapons of mass destruction (WMD) proliferation, WMD interdiction and elimination, domestic and foreign consequence management, law of armed conflict and anticipatory self-defense. From March through July 2011, Richard was seconded to the Office of the Undersecretary of Defense for Policy where he assisted in developing the U.S. response to the Fukushima nuclear crisis in Japan. At NDU, he is the course director for three courses: The Gravest Danger: Countering WMD; Responding to Catastrophic Events: Consequence Management and Incident Response; and, International Law of Armed Conflict. He is an adjunct professor of law and politics at Catholic University and Georgetown University and teaches a number of law and security related courses. Previously, he served as counsel for the Financial Crimes and Security Project at the Brookings Institution and as an advisor on homeland security for the Council on Foreign Relations.

Tomoko Steen currently serves as a Senior Research Specialist in the Science, Technology, and Business Division at the Library of Congress. Wearing her academic hat, Dr. Steen has lectured at Johns Hopkins University, the George Washington University, Harvard University (i Museum of Comparative Zoology), Emory University, and Cornell University on such topics as Evolutionary Biology, Population Genetics, Radiation Health, , , Bioethics and Science Diplomacy and Policy. Prior to entering the academic career, she also worked as a licensed clinical pharmacologist both in Japan and the US. She is the author of numerous publications covering broad range of topics from molecular evolutionary clock, history of radiation health, biological and nuclear weapons history, women in science, and biographies of world-class scientists, including two pioneer Japanese geneticists (Tomoko Ohta and Motoo Kimura).

Elizabeth Prescott works at the National Defense University and is an adjunct faculty at Georgetown University. Previously, she served at the U.S. Department of State as a Special Assistant to the Deputy Secretary of State for Management and Resources; Counselor to the Science and Technology Adviser to the Secretary of State; and S&T Adviser to the Assistant Secretary for the Bureau of East Asian and Pacific Affairs. She also served as Practice Head for Biosecurity at the Eurasia Group; AAAS Congressional Fellow for the Senate Committee on Health, Education, Labor and Pensions working for Senator Edward M. Kennedy; Research Fellow at the International Institute for Strategic Studies-US; Fellow at the National Academy of Science's Board on Science, Technology & Economic Policy; and consulted for the Strategy Division of the National Health Service in the United Kingdom. Libbie has her doctorate in molecular biology from the University of Oxford, Balliol College and dual degrees with high honors in Economics and Molecular & Cell Biology from the University of California, Berkeley.

Evagelia Laiakis is an Assistant Professor at Georgetown University in the Biochemistry and Molecular & Cellular Biology department. She earned her doctorate in Human Genetics

from University of Maryland at Baltimore (UMB) where she concentrated on inflammatory processes contributing to the perpetuation of radiation induced genomic instability. Her current research focuses on radiation metabolomics to not only study radiation related metabolic changes, but also to generate radiation signatures. As such, metabolomics has been applied to easily accessible biofluids (urine, blood, saliva) for the rapid identification of exposed individuals as a point of care in the case of a radiological event.

Heather Meeks joined the Defense Threat Reduction Agency, Research and Development Directorate in 2010. Meeks developed and manages a research portfolio in the life sciences, with a particular focus on development of countermeasures against radiation and use of biological systems for nuclear proliferation monitoring. Presently, countermeasures research involves study of organisms naturally resistant to the effects of ionizing radiation in order to characterize the intracellular environment following irradiation and to identify strategies for mitigating radiation insult. Research in biomonitoring involves manipulation of biological recognition elements, including microbial systems and enzymes, for incorporation into standard detection platforms.

Astrid Lewis currently works in the U.S. Department of State.

4:55 – 5:00
Closing Remarks

Dr. Richard Calderone

Chair & Professor, Department of Microbiology and Immunology, Director, Biomedical Science Policy and Advocacy Program, Georgetown Medical School

BIOGRAPHY

Dr. Richard Calderone is Professor & Chairman of the Department of Microbiology & Immunology. He is also Director of the M.S. program in Biomedical Science Policy & Advocacy. He obtained his Ph.D. from West Virginia University in 1970 and has been at Georgetown since 1974. The focus of Dr. Calderone's research is on the two most common fungal pathogens of immunocompromised patients, Candida albicans and Aspergillus fumigatus. He uses molecular biological and biochemical approaches to identify new targets on these fungi that can be exploited in drug discovery. In this regard, the potential drug targets that have been identified are two-component signal transduction proteins. In addition, in C. albicans, our studies focus on DNA repair and identifying unique proteins that may have potential as drug targets. While collaborating with a medicinal chemist, he has discovered four compounds in patent that he hopes to further develop.

WORKSHOP SESSIONS

October 31, 9:00 – 12:00 (Concurrent Sessions)

1. Biological and Health Effects of Radiation
2. Clean Energy, Nuclear Power, and Science Policy: What are the Solutions?
3. Nuclear Disaster Management: Clean Up Strategies

Workshop 1. Biological and Health Effects of Radiation

Led by Drs. Evagelia C. Laiakis, GUMC, and Heather Meeks, DTRA

- Adopt the precautionary principle for funding regarding policy issues.
- Consider what may constitute a valid/adequate control profile for comparing with the affected populations (sample selections, sampling methods, locations, etc).
- Evaluate bioaccumulation and biomagnification for radiation and other variables under study, and investigate the potential correlation/interrelationship between the co-accumulated factors.
- Consider data accessibility for (background) radiation levels across geographic locations and vertical stratifications ("radiation google map").
- Study the potential secondary distribution of radiation effects from the primary study conducted in the accident area (e.g., equipment cross-contamination).
- Study radiation resistance mechanisms and compare between radiation accident-affected areas and animals that "naturally" are found to be radiation-resistant.

Workshop 2. Clean Energy, Nuclear Power, and Science Policy: What are the Solutions?

Led by Dr. Tomoko Steen, GU; Notes taken by: Merc Fox, PhD candidate, STS Program, Virginia Tech University.; Dr. Seth Haldol, Harvard law School; Dr. William Jack Schull, Schull Institute; Ms. Astrid Lewis, U.S. Dept. of State; Dr. Norman Neureiter, AAAS; Dr. DP Yeh, Fermi National Lab

Communication with the public

- Avoid perceptions of secrecy, and misunderstandings – Japan lost its trust in government post-Fukushima.
- Chains of command delay messages, and U.S. government should utilize more effective communication styles (online and twitter, state and national news, use Emergency Broadcast System for announcements).
- American political culture is very difficult to change; policy recommendations are not necessarily accepted or employed and unlikely to effect change.
- Identify "most trusted" institutions to disseminate information (in Japan, the schools; in the U.S., Veterans of Foreign Wars (VFW) and churches).
- Expand the Emergency Broadcast System (EBS) to include more novel networks, such as Audubon birders, National Wildlife Service, phone app users, Search for Extraterrestrial Intelligence (SETI) approach that allows large network of participants to contribute crowd-sourced data.
    - ProMed model can be used to determine which messages are sent through the EBS.

Climate change

- Quit spending time discussing the statistics and science; it is time to take action.
    - Discussion and review panels are usually populated by industry and regulators with biased viewpoints that reflect and encourage status quo.
- Clean Power Plan is driven by climate change, and requires states to comply with new CO_2 regulations.
- 20% of electricity comes from nuclear, and about 6% of America's energy is from nuclear (as of 2015).
- Promote energy efficient technologies like compact fluorescent lights (CFL) and light emitting diodes (LED).

Costs

- In some jurisdictions, solar power is equivalent to retail electricity.
- In Hawaii, the new policy the public utility commission canceled net metering. Solar is now so low that it no longer needs to be subsidized.

Funding

- Phase out tax subsidies over the next few decades and allow industry to invest and build, with revenues coming from electricity users.
- Provide tax credits for social security income (SSI) recipients to install and use solar.
    - Maryland has a fuel fund to assist households that can't afford heat in the winter; that fund should invest in new renewable power options (solar, for instance) that provide cheaper power to everybody. **Idea:** NGOs should partner with renewable industry to enable this program.
- Solar Cities Business Model: Massachusetts and others allow homeowners to lease their roof space to private companies that install solar, sell the primary power to the homeowner, and the company takes tax credits and sells excess to the grid.

Distribution and Infrastructure

- US doesn't employ current infrastructure technologies that are found in other places, like the Netherlands.
    - Smart highways use special paints that change colors with changing conditions.
    - In the US, smart cars could engage with smart highways to preserve functions, like fog lights, until they are needed and conserve overall energy usage by the vehicle
- Technology Parks should design and research Smart City projects and work closely with U.S. government, industry and investors.
    - San Francisco, Johns Hopkins, Melbourne's ACERA (Australian centre for excellence) have models.
    - Promote a program that connects people with great ideas ("garage thinkers") to investors, industry, government, and other Technology Park stakeholders.
- Convert all US. Postal Service, school buses, public transit to electric that are wirelessly charged (induction and nanotechnology, for example; National Institute of Standards and Technology has research in this area).
- Large-grid, remote-distribution systems should be improved and replaced by microgrid and localized grids (cities, counties, large facilities, etc.) that employ multiple energy production approaches: solar, wind, small modular reactors (SMR) nuclear, geothermal, and so on.
- Many locations produce more than they need and export their energy, but do not themselves employ sustainable options for their own use (Las Vegas, for instance).

Workshop 3 Nuclear Disaster Management: Clean Up Strategies

Led by: Prof. Richard Love, NDU

Emergency response

- More than one communication method is required.
- A contingency command center should be established – we need to be clear about the chain of command and who to talk to in order to obtain information efficiently.
- There is a need for surge capacity – what if there are simultaneous crisis events?
- **Backup plans for emergency situation** should be established – embassies need to have this information for international events (e.g., part of the Foreign Service who knows the situation on where to obtain information).
    - Embassies have training for crisis responses but not for chemical, biological, radioactive, and nuclear (CBRN) events. **Idea:** How about DHS personnel in each embassy overseas?
- Pre-authorization (allocation) for money in case of CBRN events should be provided.
    - For example, something similar to the Foreign Disaster Relief for Haiti.
    - Appropriations of these funds would be faster than starting from scratch.
- Open systems thinking about who can help in emergencies is needed.
    - Specifically: Who manages the consequence? Who has the capability to manage the consequence?
    - Do not shoulder the responsibility on the U.S. alone, but work together with the international community who have the capability and resources for help, such as Singapore and Australia.
- **Rumor control** is important. Strategic communication about the situation make people more willing to help in recovery, although this is equally important during response and recovery.
- **Official communication hotline for public questions** is needed. This is sent to one place and the information is distributed in the media.
- **Emergency systems need to talk to each other.**

Factors to consider during recovery

- Symbolic impact of the incident
- Where to move those affected
- Consider impact on wildlife and people

How we can be prepared for recovery

- Learn all the lessons from the Fukushima clean-up.
- Think about what we need to do.
    - What is the situation? Who conducts the triage? We need to know where to get information.
    - Make sure you take care of yourself first – if we have methods and easy ways test, train the public on how to do it. Basic training could be incorporated in schools.
    - Now we have emergency managers (NIMS certification – How to do incident command and emergency response).

How the U.S. can help others in recovery

- Open lines of communication with the host nation.
    - Scenario development table-top exercises and red teaming can help, as can capabilities assessments, training, and investment in such activities.
- Think about what we have, and what they need.

DEPARTMENT OF DEFENSE

DEFENSE THREAT REDUCTION
AGENCY
8725 JOHN J. KINGMAN ROAD
STOP 6201
FORT BELVOIR, VA 22060
ATTN: H. MEEKS

DEFENSE TECHNICAL
INFORMATION CENTER
8725 JOHN J. KINGMAN ROAD,
SUITE 0944
FT. BELVOIR, VA 22060-6201
ATTN: DTIC/OCA

DEPARTMENT OF DEFENSE CONTRACTORS

QUANTERION SOLUTIONS, INC.
1680 TEXAS STREET, SE
KIRTLAND AFB, NM 87117-5669
ATTN: DTRIAC